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## SOLUTION I.

Let  $D$  denote the diameter of the sphere,

$H$  altitude of the dome.

$r$  radius of its base,

$h$  altitude of the cone ;

then  $r^2 = DH - H^2$ ,

and the volume of the dome, being the difference of the volumes of the sector and the cone whose vertex is at the centre of the sphere, is

$$\frac{1}{6}\pi HD^2 - \frac{1}{6}\pi r^2(D - 2H) = \frac{1}{6}\pi H^2(3D - 2H).$$

The volume of the required cone is, again,

$$\frac{1}{3}\pi hr^2 = \frac{1}{3}\pi Hh(D - H).$$

The two volumes are equal by hypothesis ;

$$\therefore \frac{h}{H} = \frac{3D - 2H}{2D - 2H}. \quad [\text{Charles Puryear.}]$$

## SOLUTION II.

Let  $D_1$  be the diameter of the base of the dome ; the condition gives

$$\frac{\pi}{12}D_1^2h = \frac{\pi}{8}D_1^2H + \frac{\pi}{6}H^3;$$

$$\therefore \frac{h}{H} = \frac{3}{2} + \frac{2H^2}{D_1^2}.$$

But

$$\begin{aligned} D_1^2 &= 4H(D - H); \\ \therefore \frac{h}{H} &= \frac{3}{2} + \frac{H}{2D - 2H} = \frac{3D - 2H}{2D - 2H}. \end{aligned} \quad [\text{R. D. Bohannan.}]$$



## EXERCISES.

## 70

A RIGHT ANGLE moves so that a given point in one side, distant  $c$  from the vertex, lies in a fixed axis, while the other side passes through a fixed point, distant  $c$  from this axis. Find the locus of the instantaneous centres or centrodes of the motion. [R. H. Graves.]

## 71

A LINE of unit length is bent to the arc of a circle such that the area of the segment it determines is a maximum. Find the radius of the circle and the form and area of the segment. [O. Root, Jr.]

## 72

CIRCLES of given radius are drawn through the focus of a fixed parabola, cutting the curve in four points. Show that the products of the focal radii to these points are all equal. [W. M. Thornton.]

## 73

IF  $r$  is the radius of the inscribed circle of a triangle and  $\rho$  the radius of the triangle whose vertices are the feet of the altitudes of the given triangle,

$$r > 2\rho. \quad [R. D. Bohannon.]$$

## 74

FOUR points are taken at random on the surface of a sphere. What is the probability, that all of the points do not lie in the same hemisphere?

[A. Hall.]

## SELECTED.

## 75

REDUCE to its simplest form

$$\cot(x_0 - x_1) \cot(x_0 - x_2) \cot(x_0 - x_3) + \cot(x_1 - x_0) \cot(x_1 - x_2) \cot(x_1 - x_3) \\ - \cot(x_2 - x_0) \cot(x_2 - x_1) \cot(x_2 - x_3).$$

## 76

FIND the condition that the cubic

$$6x^3 - (2n + 8)x^2 + n(n + 1)x + n(n + 1)(2 - n) = 0$$

may have equal roots.

## 77

CONSTRUCT a square; given one vertex and two parallel lines on which the extremities of the opposite diagonal are located.

## 78

$A, B, C$  are the points of application of three parallel forces  $x, y, z$ ;  $Q$  is their centre;  $\rho$  is their resultant;  $p, q, r$  are the radius vectors of  $A, B, C$  measured from an arbitrary origin  $M$ . Show that if  $MQ = h$

$$h^2 = \frac{p^2x + q^2y + r^2z}{\rho} - \frac{a^2yz + b^2zx + c^2xy}{\rho^2}.$$